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ABSTRACT

This report examines individualized instructional approaches to teaching, reviews of the literature in that field with specific reference to Upward Bound programs, and reports on a research study which investigated the relationship between an Activity Based Curriculum (ABC) and the academic performance of economically disadvantaged high school students. Seventeen students were treated with the independent variable, the ABC, while another seventeen with the same characteristics were used as the comparison group and not exposed to ABC. An analysis of grade point averages of all students indicated that those involved with ABC achieved significantly higher grade point averages than non-ABC students. Suggestions are made for further research on this instructional approach. A bibliography and tables are included. (Author/WP)

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THE EFFECTS OF AN ACTIVITY BASED CURRICULUM (ABC) UPON THE ACADEMIC ACHIEVEMENT OF DISADVANTAGED HIGH SCHOOL STUDENTS

A brief analysis of the individualized instructional approaches to teaching is presented along with a systematic, vigorous review of the body of material pertinent to innovative teaching within the milieu of Upward Bound programs. An examination of the theoretical and psychological foundations of the teaching methods is presented. The experiment investigated the relationship between an Activity Based Curriculum (ABC) and the academic performance of disadvantaged high school students. In the experiment, 17 students were treated with independenc variable, the Activity Based Curriculum. Another 17 students with the same characteristics were used as the comparison group and not exposed to ABC. An analysis of grade point averages of all students indicated that ABC-exposed students achieved significantly higher grade point averages than non-ABC students. The results indicated some advantages of the ABC design, and suggestions for future research for this instructional approach are made.

This research is based upon a dissertation submitted to the University of Massachusetts at Amherst in partial fulfillment of the requirements for the doctoral degree. The author expresses his gratitude to C. Dalton Jones for his constant encouragement for this project, to Howard Gadlin, Robert S. Feldman and Douglas Forsyth for serving as members of the dissertation committee. Also, appreciation is expressed to the Upward Bound program. Requests for reprints should be sent to:

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Statements of the Problem

Beginning in the early 1960s, there evolved a great proliferation of Upward Bound programs for the purposes of improving the educational opportunities for students that have been labeded "culturally deprived", "disadvantaged" or "underachievers". Social scientists felt that compensatory education was one means through which these students could be assisted in achieving educational equality. Thus, Upward Bound, by definition, is a "pre-college preparatory program designed to generate the academic skills and motivation needed for success in education beyond high school preparation" as stated in the Upward Bound Guidelines (Note 1). As a result of the zeal to move forward quickly toward overall program success and subsequent evaluations (Burris, 1969; Connors, 1970; Egeland, Hunt, and Hardt, 1970; Ehrbright, 1969; Henderson, 1969; Herson, 1968, Hunt and Hardt, 1969; Jawa, 1969; Strauss, 1969; Zamoff, 1969), evaluations of program curricula have frequently been neglected.

One of the purposes of this study is to provide a systematic, rigorous evaluation of the available literature pertinent to program curricula and innovative teaching methods developed within the context of Upward Bound programs. Evaluations of these methods could lend

meaning and direction for future programs, and also advance the knowledge of the population of students that Upward Bound programs serve. Additionally, understanding of the presentation of subject matter through innovative methods, will advance newer teaching methodologies.

One of the major problems of the schools that are located in low-income areas is that few students are actually prepared to go on to some form of higher education. In 1964, the Zacharias Panel on Educational Research and Development stressed the need for compensatory education, and reported that 5 per cent or fewer of low-income students enroll in postsecondary institutions (Zacharias, 1964). Gordon (1965) identified several approaches to the successful implementation of compensatory educational programs. Included in his approaches were the development of new teaching methods for reading and language, innovative curricula with the aim of individualizing instruction, and increasing the relevance of the material that is to be utilized in the classroom. This review emphasizes the innovative approaches to teaching because of the belief that a creative, relevant curriculum that focuses upon the needs of the individual is the key to bringing about change or improvement in academic achievement. In this manner, another purpose of this study is the assessment of academic gain among Upward Bound participants involved in a new approach to teaching mathematics. The Activity Based Curriculum (ABC), was designed to develop the cognitive abilities of students enrolled in mathematics courses.

Although the immediate concern for this study is the assessment of academic achievement within the context of an ABC, full consideration is given to the fact that there are aspects of the Upward Bound

program which suggest other influences upon academic achievement. However, to limit this study in accordance with academic achievement is certainly consistent with the stated objectives of the Upward Bound program.

Literature Review

The major purpose of this review is to examine the various literature available on innovative instructional approaches to classroom teaching within the context of the summer programs of Upward Bound Projects. A brief overview of the methodology and the underlying theoretical and psychological tenets will be developed for each approach. The recurring theme for all of the instructional approaches is the development of academic potential among underachieving high school students.

The teacher in an Upward Bound program must possess the expertise to develop this academic potential that is often untapped in these youngsters, and is also in a position to exert tremendous influence upon the attitude, motivation, and overall behavior of the students. These teachers are college graduates that have classroom experience with their particular subject matter, but must also possess the wherewithall necessary to be able to develop positive attitudes toward material, and personal maturity among the participants. Different, creative, and relevant instructional approaches to the presentation of the material can go a long way towards these goals. Therefore, attention to the individual might be one of the methods used in the development and implementation of an innovative teaching approach. The next section of

this paper will briefly survey the individualized instructional approaches to teaching, with consideration of the underlying psychological foundations, prior to the review of Upward Bound literature. Hopefully, this survey will provide the reader with a psychological framework for the review of the innovative teaching methods developed for Upward Bound participants.

Individualized instructional approaches.

The history of individualized approaches to instruction may be traced back approximately sixty-five years when Washburn (1913) described the individualized method used in San Francisco and Winnetka, Illinois. However, the recent proliferation of individualized instructional methodology on college campuses, universities, and public school systems has been attributed to Keller (1968), with an extension documentation of the increased use of the Keller Plan compiled by Hess (1972).

The Keller Plan or Personalized System of Instruction (PSI), has the following major tenets: a) individually paced instruction, b) a criterion referenced grading system, and c) a tutorial component. The first tenet allows a student to complete the course in half of the normal time or to take twice as long to complete the course of study. Secondly, a student's grade does not depend upon the performance of peers in the same class. That is, there is no "normal curve," and upon mastery of approximately ninety percent of the unit material, the student is allowed to advance to the next unit. The student is allowed to take the unit test as many times as necessary to achieve mastery. Finally, a tutorial component is employed as either teacher aides or advanced students tutor the slower students.

In addition, PSI is supplemented with lectures, discussions,

demonstrations, films and slides where appropriate. Guest lecturers, cassette recordings, and videotapes are also frequently utilized. Basically, the organization of PSI is quite flexible, and the details are left to the discretion of the instructor. The empirical evidence from a number of studies conducted at the postsecondary level by Hess (1972) indicate that PSI has been highly successful when compared to traditional courses.

Another approach to individualized instruction developed during the late 1960's was labeled Individually Prescribed Instruction (IPI), and the success of this method has been documented by Lindvall and Bolvin (1966). The major feature of the IPI design is the specification of behavioral objectives for each unit of study. These behavioral objectives include specific descriptions of the terminal behavior of the student in ways that are measurable. For example, a college level psychology course might specify that the student should be able to: 1) differentiate between humanistic and behavioristic approaches to teaching, and 2) identify the fundamental objectives of experimental and correlational methods in educational psychology. These objectives are measurable in oral and written form and are far more precise than stating that the student should know or understand. Mastery learning is also used in the IPI method in the same manner that it is used in the PSI method.

The objectives specified in an IPI method should be stated in the clearest possible form with all the conditions indicated for achieving criterion level. The student must know the minimum acceptable

level of performance, so that the fundamental objectives of the teacher are clear. As in the PSI system of instruction, the student in IPI may take the unit test(s) as many times as necessary to achieve criterion.

The research findings pertinent to the IPI design are limited, but Scanlon, Weinberger, and Weiler (1970) reported that IPI students performed significantly better than two control groups. Other literature that focuses upon assessment of the IPI method has produced findings that are inconclusive.

There are several teaching approaches to individualized instruction that involve the use of the computer. One of these approaches is the Program for Learning in Accordance with Needs (PLAN). The PLAN approach involves the specification of behavioral objectives, and utilizes mastery learning. However, the major difference between the PLAN approach and PSI is the use of the computer into which test scores are fed each night, with a printout received and evaluated the following day. The computer also generates weekly and monthly reports on each student involved in the course. Flanagan (1968, 1971) has evaluated PLAN programs with the results inconclusive and limited. Other computer-based individualized approaches that also have inconclusive research findings are Programmed Instruction (PI), Individually Guided Education (IGE), and Computer Assisted Instruction (CAI). Essentially, computer assisted instruction has become a supplementary approach to teaching and has not become the major approach that Skinner (1954) envisioned over twenty years ago. The major disadvantage to this kind of instructional approach is that the computer facilities and the services for the handling of the

test data are quite expensive. Finally, the evaluations of computer assisted instruction have not clearly demonstrated major advantages over non-computer based methods.

The next section will be devoted to an analysis of the literature that is available regarding individualized and innovative approaches to teaching, within the context of Upward Bound programs. These approaches were used during the summer phase conducted on college and university campuses in which instructors attempted to develop and implement innovative teaching approaches.

Teaching psychology.

An innovative approach to teaching psychology to Upward Bound students was developed by Rappaport and Sorensen (1971). This approach attempted to draw upon the relevance of life experiences of the participants by incorporating these experiences into the curriculum. The assumption underlying this method was that the relevance of psychology could be enhanced by utilizing a psychobehavioral perspective and a particular style of delivery within the classroom.

The psychobehavioral perspective stresses an action-oriented approach which views behavior as a result of observable antecedent and consequent behavior. This approach emphasizes concrete behaviors, reinforcements, and contingencies that are related with behaviors. Community psychology complements this perspective by attempting to focus upon the poor and the disadvantaged by communicating understanding of human behavior to the community, often called "giving psychology away."

The purpose of the study by Rappaport and Sorensen was to develop the ability of Upward Bound students to deal with problems of living, through a psychology class. The class also attempted to develop a more realistic attitude towards self, an increased understanding of human behavior, and a better understanding of causality. There was also an attempt to develop a style of delivery of the information relevant to the needs of disadvantaged high school youths.

The students involved in this study were participants in the Upward Bound program located at the University of Illinois at Champaign-Urbana. This program had a summer phase that involved 11th and 12th graders over a seven-week period enrolled in courses in English, mathematics, history, and psychology.

The psychology classes were taught to a total of forty students, who were assigned to five separate groups of eight students each. The classes met twice weekly for an hour period, over the seven week summer program. Therefore, there were fourteen class meetings for each group of students. The curriculum for the course included material selected according to; a)usefulness in the student's life, b) reflection of psychological principles and applications, and c) maintenance of student attention. The following topics were included in the curriculum:

1. A model of human behavior that observed behaviors could be related to, and organized around.
2. The concepts of reward and punishment.
3. The influences and contributions of heredity and environment.
4. The concepts of perception and cognition.

5. The design of experimental procedures.
6. The actual step-by-step implementation of experimental designs.
7. The concepts of psychosocial development.
8. The concept of intelligence.
9. The influences of anxiety and mental illness upon behavior.
10. The influence of the social system upon the individual.

In one particular class session, students were paired into experimenter-subject dyads with data collected on a subject of interest. This was followed by a discussion of statistical test, hypothesis testing, probability testing, and t-tests. The researchers felt that the students understood the basic rules of experimental design and methodology as they relate to the behavioral sciences, and also had developed their capabilities for solving problems.

This particular project was not designed as experimental research, but the results of a 25-item test of knowledge of psychological principles were evaluated. This test was administered during the first and last weeks of the Upward Bound summer program, to determine if any factual knowledge was transmitted as a result of the psychology class. The results indicated a significant improvement in the test scores, indicating that at least some information had been transmitted to the students.

The style of delivery was such that classes were conducted informally, with a good deal of teacher-student interaction taking place. Students were encouraged to make in-class presentations and lead discussions, with the discussions often incorporating topics that the students were discussing informally when they arrived for class. The teachers made attempts to integrate these informal pre-class discussions

into the daily lesson plan, hoping to change negative attidues towards school. The researchers found a significant change in the students' attitudes towards school and self during the summer program. These results were measured by a psychometric test designed to assess attitude change, but must be interpreted cautiously because there was not a control group from which similar data was gathered. Finally, the researchers felt that the project, with the particular curriculum and delivery style, demonstrated the relevance of psychology to disadvantaged high school students.

Teaching earth science.

A method of teaching earth science to Upward Bound students enrolled in the program at Colorado State College was developed and implemented by Bybee (1969). This instructor felt that the teacher must really provide motivation based upon relevance, interest, and the involvement of students in class activities. Further, Bybee felt that the instructor must utilize all available resources and truly teach the subject matter, while possessing a humanistic philosophy with the emphasis upon providing individualized instruction.

This study took place during the summer phase of the Upward Bound program and involved eighteen senior students enrolled in a college earth science class. The regular summer school students enrolled in the same course were utilized as a comparison group. There were economic and educational inequalities that existed between the families of the Upward Bound students and the families of the comparison group. Indeed, 80% of the Upward Bound families had incomes of less than $7,000, while 80% of the comparison group families had incomes that exceeded

$7,000, with 50% above the $10,000 level. Also, the families of the Upward Bound students were larger, and the parents had generally less formal education than the comparison group.

The entire class was administered both the Comprehensive Earth Science Examination developed by the Psychological Corporation in conjunction with the Earth Science Curriculum Project, and the Test on Understanding Science, Form W, produced at Harvard University and distributed by the Educational Testing Service. These tests were administered in both pre-test and post-test situations, and the statistical method utilized was an analysis of covariance.

The earth science class consisted of three lectures a week for a ten-week period, and the approach the instructor used allowed for student participation in the class via the encouragement of questions and responses. In addition, there were several films presented, laboratory-discussion sessions, and audio-tutorial sessions for all students. The class also went on several field trips during the summer session.

The results of the statistical analysis indicate that there were no significant differences between the two groups on either of the tests. Further, for the Test on Understanding Science, a comparison for each of the following areas produced no significant differences between groups.

1. Understanding about the scientific enterprise.
2. Understanding about scientists.
3. Understanding about the methods and aims of science.

From these results, it may be inferred that the Upward Bound students knew as much about earth science as the general population of college students. Regarding the prior education of the two groups, about 61% of the Upward Bound students had taken a laboratory-oriented science course, and about 30% had taken a high-school earth science course. The percentages were approximately the same for the comparison group. It was also noted by the instructor that the attitudes, interests, in-class participation, and ratings of the class, were not significantly different for the two groups.

This research indicates that Upward Bound students do not stand out as a group unable to achieve, and that many talented students from deprived areas of the country have college potential. Bybee estimated that there are approximately 600,000 students with college potential and that Upward Bound reaches about 4% of these students.

Teaching English.

Covey (1969), developed research that attempted to investigate and improve the verbal skills and communication levels of Upward Bound students enrolled in an English class. The study involved an English class at Marymount College in Palos Verdes Estates for Upward Bound girls. The instructor had taught the course the previous summer, and had become frustrated because the girls were extremely quiet and reserved, and never challenged the conclusions presented by the teacher. The occasional discussions that took place were not very lively, and most of the discussions floundered because of noncommital and nonverbal students. The students also had great difficulty writing their ideas down on paper. Thus, the instructor realized that a drastic change in the teaching of these

students had to occur in order for the students to learn how to communicate better.

The new approach to teaching this English class involved a laboratory approach which supplemented books with a rich variety of communication devices such as videotapes, sound tapes, films, slides and records. Student assignments could be presented via the particular medium that they chose. One presentation was made by a student using an overhead projector and transparencies, while two other students used sound tape, and another used cut-and-paste college scrolls used with an opaque projector.

Another change in the class was the requirement of a daily parpgraph written in class on a subject of their choice. Gradually, as presentations occured more frequently, the daily paragraphs required less time to write as ideas were transformed into words much easier. The girls began to communicate more freely with each other and the instructor, as often discussions occured around solving problems related to preparing visual and oral presentations.

Although the research did not include any control group or statistical analysis, the instructor felt that the laboratory method of teaching English helped nonverbal Upward Bound girls identify and develop their own method of communicating. The instructor also felt that the girls began to develop better verbal communications, and that teachers need to be more receptive to nonverbal and verbal messages from their students. The recommendations for further research in this area include helping nonverbal youth explore new methods of communicating, by utilizing laboratory facilities as a part of English courses.

Teaching reading.

Research by Rushmore and Scope (1969) focused upon a special reading program for Upward Bound participants at Hofstra University. An assessment of the students prior to the summer program revealed that 60 of the 98 students in the program needed special help in reading. Therefore, these students were assigned to a special reading class taught by the staff of the Reading Center of the university.

These students were 10th through 12th graders and were reading at 5th to 7th grade levels. Approximately half of the students were from the ghettoes of New York City, while the remainder were from the poor sections of Nassau County. The participants were Black, White, and Puerto Rican students, and some were eager to participate while others were not interested.

The reading class was taught in an informal manner, with voluntary attendance. The students were encouraged to read independently and the classes consisted of general discussions, writing, and oral reading. The oral reading was developed from student participation in plays conducted in class. The play, "Raisin in the Sun" was quite successful and was taped in the classroom as students portrayed their roles quite convincingly. Some of the books that were read in and outside of class were Yes, I Can, by Sammy Davis, Jr., and Down These Mean Streets, by Peri Thomas. These books stimulated lively discussions around the topics of prejudice, bigotry, identification and drug addiction. In addition, the Doubleday Zenith Series of Bibliographies This series depicts famous Black people, facts, and incidents in Black

history. Although the reading levels were 5th through 7th grade, the books entitled Four Took Freedom, Lift Every Voice, and Pioneers and Patriots, helped the increase their awareness of their heritage and American history. Discussions and role plays based upon these books were extremely successful.

The Macmillan Gateway Series was also used to illustrate different attitudes and values. Lively discussions evolved from these books and the O'Henry story entitled, "After Twenty Years," which involved the topics of individual responsibility toward a friend and to society. In addition, the local newspaper proved to be accepted better than some of the more traditional academic material. Namely, the students were keenly interested in current events and had definite opinions regarding particular news items. Through the reading of newspapers, the teaching of certain comprehension skills was facilitated. These skills included: getting the main idea, critical analysis, and the interpretation of pictures and maps. The crossword puzzles were used for vocabluary development and the cartoons were utilized to interpret ideas.

Following the reading program, a reading test was administered to the Upward Bound students to assess the impact of the program. Unfortunately, the students had developed very strong negative attitudes regarding tests, with disastrous results. The Triggs Diagnostic Reading Test was used, but some students refused to take the test, while others merely went through the motions of taking the test. Even though the results were poor, most students performed better on the general story and vocabulary, than on the higher comprehension skills such as

making inferences from given information. A conclusion drawn from this research was that the results of the reading program could not be measured by standardized tests. A more important conclusion was that for some students, certain attitudes toward self and education had been changed in a positive manner. Student counselors and teachers had been using their spare time to read books and newspapers, and the students had begun to realize the importance of books and education in their lives.

Tillman (1976) studied the relationship between personality types and reading gains of Upward Bound participants at the University of Florida. This particular research was based upon earlier findings by Myers (1962) and followed up by Schmidt and Fretz (1965), which indicated that improvement in reading scores was related to certain combinations of teacher-pupil characteristics. These characteristics were studied using the Myers-Briggs type indicator, which is a personality inventory. These earlier research findings indicated that students that tend to be impulsive had a higher reading rate than student that tend to be constricted. The purpose of the research by Tillman was to attempt to determine which personality variables, if any, would be related to reading gain.

The students involved in this research were enrolled in a highly individualized reading program developed for Upward Bound students by Tillman and Jackson (1972). There were fifty students involved in the study and included sixteen males and thirty-four females. There were thirteen 11th graders, and thirty-seven 12th graders, and thirty-three of the participants were Black and seventeen were White. The

mean grade point average of these high school students was 2.54 on a four-point scale, with a range of 1.5 to 3.6 The students were administered a pre-test using the Stanford Diagnostic Reading Test, Comprehension Section (Form W, Level 2), and the mean grade level was 8.9, with a range of 4.8 to 12.6. Sixty-eight percent of the students scored two or more years below their grade level and were classified as poor readers.

Prior to the summer program, the students were given the Myers-Briggs Type Indicator, Form F, which contains 166 items and the following four dimensions;

1. Extroversion(E)--Introversion(I).
   this dimension focuses upon the interests of the individual towards persons(E) or ideas(I).

2. Sensing(S)--Intuition(N).
   this dimension focuses upon how the individual perceives realities (S) and experiences (N).

3. Thinking(T)--Feeling(F).
   this dimension analyzes judgements in terms of logical order and the focus is on causality(T) or personal values(F).

4. Judging(J)--Perception(P).
   this dimension focuses upon how the individual decides to control events(J) or perceives events(P).

These four dimensions, each with two indicators, form sixteen possible personality types.

The results of the Tillman study indicated that 70% of the Upward Bound students preferred sensing(S), 60% preferred feeling(F), and 66% preferred a judgmental approach (J) to the world. No significant difference was found in the extroversion-introversion dimension of the personality scale. A statistical analysis was selected that calculated

the proportion of poor readers associated with each personality dimension. The results of this analysis indicated that for two dimensions, Sensing-Intuition, and Thinking-Feeling, the proportion of poor readers was significant. Students who preferred feeling(F) included fewer poorer readers but made more significant reading gains than students that preferred thinking(T). This result was contrary to the prediction that feeling oriented students would benefit the most from a counseling-oriented program such as Upward Bound. Students who preferred intuition (I) included fewer poorer readers, but they did not make significant reading gains over those who preferred sensing(S). Overall, the results were in the predicted directions, and the conclusions indicated that personality types suggest matching students to particular teachers, techniques and procedures for reading programs.

Lloyd (1968) developed a reading program designed to provide a positive learning experience for Upward Bound students at Wittenberg University. The reading program was eight weeks in duration and included seventy-four students, of which thirty-nine were male and thirty-five were females. The students were divided into five groups, each of which met for three fifty-minute periods of reading instruction per week. The major emphasis of the course were reading speed, vocabulary drill, and reading comprehension. In order to increase reading speed, the instructor utilized a tachistoscope, reading films and other mechanically controlled reading devices. In order to facilitate the development of vocabulary, the students were required to make and use vocabulary cards based upon the methods developed by Meilman (1967). The development of reading comprehension was based upon previous research compiled by

Robinson (1962) which included an emphasis upon proper study skills. Finally, a series of lessons on Latin roots and prefixes were incorporated into the curriculum.

A pre-test and post-test of reading skills was administered to the Upward Bound students, and the results of the gains and losses for each student were tabulated. The average gain for the males was 4.8 months, while the females gained an average of 6.4 months. Twenty-seven of the thirty-nine males made gains ranging from one month to three years and seven months. Also, twenty-eight of the thirty-five females made gains ranging from one month to three years and one month. The objective data indicated that the reading program was a success. Additionally, a twenty-three item questionnaire was administered during the last week of the program. The questionnaire was directed at all aspects of the course, and approximately 66% of the students rated the course between very good and excellent. Indeed, both the objective and the subjective measures indicated that the course was a success, and the recommendations included modifying the grammar instruction, providing more individual tutoring, providing more student input into the choice of reading material, and providing weekly progress reports to students regarding rates and comprehension levels.

The utilization of individualized instruction along with the development of innovative teaching methods would serve to greatly enhance the development of the individual, especially within Upward Bound programs. As this literature review illustrated, several programs have incorporated these ideas into their academic curricula, and it is hoped that other programs would follow suit in the future. Although several

studies that were reviewed are necessarily subjective, they are impressive enough to warrant continued research and use of these techniques in the future, with consideration of longitudinal research. The next section of this paper will deal with longitudinal research utilizing and Activity Based Curriculum (ABC), within the context of an Upward Bound program.

The Activity Based Curriculum (ABC) Design

The nature of both algebra and geometry are conceptual in that these subjects require performance on cognitive tasks. The definition of cognition for the purposes of this research is: the process or processes by which a person acquires knowledge or becomes aware. Also, a part of this definition of cognition includes the product of such processes. In this research, the test performances of students in both algebra and geometry are considered measures of cognitive skills. For algebra the tasks are related to the understanding of symbolic representation, while in geometry the cognitive tasks involve understanding spatial relationships.

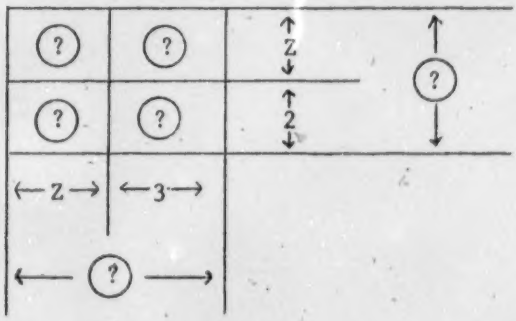
Both the algebra and geometry class consisted of three lectures a week for six weeks, laboratory-discussions twice a week, tutorial sessions three nights per week, and a weekly quiz. The class was also given homework assignments nightly, and during the last week there was a final exam. The lectures were designed and implemented as two-way communication between students and the instructor as questions were always encouraged, while at the same time attending to the daily objectives outlined on the blackboard. The laboratory-discussion activities involved the instructor as a facilitator for the workbook activities assigned either

to individuals or to specific groups of students.

The overall design of the Activity Based Curriculum (ABC) involved presenting the material in contextualized and subsequent decontextualized forms. For example, this procedure was utilized to explain the use of equations in order to solve the area of a rectangle, as the following steps illustrate.

Contextualization

STEP 1 - Visual, sight of concept - blackboard presentation.



STEP 2 - Auditory, sound of concept - explanation that Z and 3 are added together to obtain the length dimension of Z + 3. Likewise, Z and 2 produce the width dimension of Z + 2, for the rectangle.

STEP 3 - Speech, discussion of concept - students discuss the concept of "area of a rectangle" and are reminded that the area of a rectangle is the length times the width, and in this particular case the area of Z + 3 times Z + 2.

STEP 4 - Motor, action of the activity - students are assigned the problem of multiplying two terms, as $(Z + 3) \times (Z + 2) = Z^2 + 5Z + 6$. Students are asked to make up additional examples of rectangles, and to arrive at area equations for the rectangles, and also for the subsections of the rectangles.

Decontextualization

STEP 5 - Cognition, understanding the concept - students are assigned problem sets out of their workbooks for homework. The following are examples: $(X + 5) \times (X + 3) =$ or $(M + 2) \times (M + 7) =$

STEP 6 - Motor, action of the test - students are tested with similar examples.

These steps simply detail one concept in algebra from a wide range of concepts, and the explanation of numerous concepts may be accomplished in a similar manner.

The Research Question

The basic questions that this research effort attempted to answer was, "Can an Activity Based Curriculum improve the cognitive abilities and performances of disadvanted minority high school students on conceptual tasks in algebra and geometry?" The hypothesis was that the ABC design might provide these students with both concrete and conceptual contexts which would make generalized learning possible. Therefore, any gains in performance which could be attributed to the ABC should show up as incremental gains between the pre-test and the post-test scores in algebra and geometry, which would reflect acquisition of conceptual or rule-based competencies.

Essentially, the contextualization provided by the ABC design should facilitate gain in performance because of the visual and concrete stimuli designed to enhance conceptual learning. Fundamentally, contextualization took place through the use of algebra card games, blackboard diagrams, geometric models, and relevant examples of contemporary algebra and geometry problems. The same material was decontextualized in the form of a weekly quiz in the particular concepts,

designed to assess generalized learning from specific examples.

Method

Subjects and design: Study I.

The subjects that participated in the ABC research were seventeen high school students from low-income environments. Approximately half of the students were male and half were female. All of the families of the subjects met the federal socio-economic criteria for participation in the six-week summer Upward Bound Program for low-income youth. In addition, a comparison group of seventeen students that met the same criteria was used.

All of the students were recruited from urban schools located in Western Massachusetts. Essentially, the students were randomly selected for participation in the summer academic program, as each year a lengthy waiting list of eligible candidates is updated, and used for the recruitment of students. From the waiting list a comparison group of students was selected with the same essential characteristics as the ABC group.

The experimental design was a matched group, between subjects design for both algebra and geometry. In the between subjects design, each subject received only one level of the independent variable, the ABC design. The experimental and comparison groups were matched on sex, grade level, school, and on prior grade point average (GPA) in previous mathematics courses taken during the regular school year. This matching procedure was used to produce similar groups.

The research involved the collection of interval data over time.

That is, measures of grade point averages for both the ABC and the comparison groups were taken for the previous year. This measure was taken in order to match the two groups on a dependent variable. This method allowed assessment of the effect of the ABC design upon subsequent performance in mathematics. Summarizing, the independent variable was the ABC treatment and the dependent variable was the grade point average for mathematics courses over two eight-week marking periods following exposure to ABC during the summer program.

Results

Table 1 presents the matching variables used to produce similar groups.

Table 2 presents the results of the ABC treatment on the grade point average of the students enrolled in mathematics courses during the regular school year, compiled over two eight-week marking periods. This post mathematics grade point average is pooled, and includes some algebra and geometry. Originally, the ABC group and the Control group each contained twenty-nine students. However, one student dropped out of the summer program after one week, and two students moved away after the summer had ended. Another student became quite ill and had to be hospitalized shortly after entering school in the fall. Finally, an additional eight students did not take any mathematics courses during the subsequent school year, after completion of the summer program. Therefore, the two groups were reduced in number to seventeen students each.

A test for correlation between pre and post GPA's was performed, with $r = .66$. An analysis of covariance was performed using the prior

TABLE 1

Matching Variables for ABC and Control Groups

ABC Group

Subject Number	Sex	Grade	High School	Prior Math GPA	Prior Math Course
S1	M	10	Commerce	1.6	General Mathematics
S2	F	10	Hoosac	1.0	General Mathematics
S3	F	11	Holyoke	1.0	General Mathematics
S4	M	10	Holyoke	1.0	College Algebra
S5	F	11	Hoosac	2.0	Individual Study Math
S6	M	10	Commerce	1.5	General Mathematics
S7	F	11	Commerce	1.5	General Mathematics
S8	M	10	Holyoke	1.0	General Mathematics
S9	M	10	Taconic	1.0	Algebra I
S10	M	10	Classical	0.0	Albegra I
S11	F	10	Technical	0.0	Algebra I
S12	M	10	Commerce	2.0	Algebra I
S13	F	10	Taconic	2.0	Algebra I
S14	M	11	Technical	1.7	Algebra II
S15	F	10	Holyoke	2.0	Algebra I
S16	F	11	Classical	1.0	Algebra I
S17	F	10	Commerce	2.0	Algebra I

Control Group

S1	M	10	Commerce	1.5	General Mathematics
S2	F	10	Hoosac	2.0	Business Mathematics
S3	F	11	Holyoke	1.0	General Mathematics
S4	M	10	Holyoke	2.0	College Algebra
S5	F	11	Hoosac	3.0	Business Mathematics
S6	M	10	Commerce	2.5	General Mathematics
S7	F	11	Commerce	1.0	General Mathematics
S8	M	10	Holyoke	2.0	Algebra I
S9	M	10	Taconic	0.0	College Algebra I
S10	M	10	Classical	0.0	General Mathematics
S11	F	10	Technical	1.0	Algebra I
S12	M	10	Commerce	2.0	Algebra I
S13	F	10	Taconic	2.0	Algebra I
S14	M	11	Technical	1.5	Algebra I
S15	F	10	Holyoke	1.0	College Algebra I
S16	F	11	Classical	0.0	Business Mathematics
S17	F	10	Commerce	0.5	Algebra I

GPA Scale: 4.0 = A; 3.0 = B; 2.0 = C; 1.0 = D; 0.0 = F.

TABLE 2

Prior and Post Mathematics Grade Point Averages, Changes, and Group Means for ABC and Control Groups, Over Two Marking Periods

Subject Number	Age	Prior Math GPA	Post Math GPA	Change
ABC (n = 17)				
S1	18	1.6	1.0	-0.6
S2	16	1.0	3.0	+2.0
S3	17	1.0	1.5	+0.5
S4	16	1.0	3.0	+2.0
S5	17	2.0	3.5	+1.5
S6	17	1.5	2.0	+0.5
S7	17	1.5	2.0	+0.5
S8	17	1.0	1.5	+0.5
S9	17	1.0	0.0	-1.0
S10	16	0.0	0.0	0.0
S11	17	0.0	0.0	0.0
S12	16	2.0	2.0	0.0
S13	16	2.0	2.0	0.0
S14	18	1.7	2.0	+0.3
S15	16	2.0	3.0	+1.0
S16	17	1.0	1.0	0.0
S17	16	2.0	2.0	0.0
		M = 1.3 S.D.= 0.6	M = 1.7 S.D.= 1.0	M = +.4 S.D.= 0.8
Control (n = 17)				
S1	16	1.5	1.0	-0.5
S2	15	2.0	2.0	0.0
S3	17	1.0	1.0	0.0
S4	17	1.0	2.0	+1.0
S5	16	3.0	3.0	0.0
S6	16	1.5	2.5	+1.0
S7	15	1.5	1.0	-0.5
S8	16	2.0	2.0	0.0
S9	15	0.0	0.0	0.0
S10	17	0.0	0.0	0.0
S11	17	1.0	1.0	0.0
S12	17	2.0	2.0	0.0
S13	15	2.0	2.0	0.0
S14	16	1.5	1.5	0.0
S15	17	1.0	1.0	0.0
S16	16	1.0	0.0	-1.0
S17	15	2.0	0.5	-1.5
		M = 1.4 S.D.= 0.8	M = 1.3 S.D.= 0.9	M =-0.09 S.D.= 0.6

TABLE 2 (cont.)

GPA Scale: 4.0 = A; 3.0 = B; 2.0 = C; 1.0 = D; 0.0 = F.

M = Mean.

S.D. = Standard Deviation.

GPA as the covariate, and the post GPA as the dependent measure. The results are presented in the following table.

TABLE 3

Analysis of Covariance: Effect of ABC on Post Grade Point Average Over Two Marking Periods

Source of Variation	SS	df	MS	F	Significance
ABC	2.19	1	2.19	4.19	.049
Residual	16.26	31	.52		

Summary

These data indicate that there was an overall gain in GPA for the ABC group, and that this difference was significant in an analysis of covariance at the .05 level. In addition, the average gain for the ABC group was +.4 in GPA, while the Control group showed an average decline in GPA of -.09. Nine students gained in GPA, six remained the same, and two students lost in GPA in the ABC group. Only two students in the Control group gained, eleven remained the same, while four lost in GPA. The next section will deal with Study II, followed by a discussion section.

Method

Subjects and design: Study II (full year follow-up).

The subjects and design for this study were the same as utilized in Study I, and this study represents an attempt to analyze the effects of the ABC treatment on the grade point averages of the students over the full school year following the summer program. The following table presents the results.

TABLE 4

Prior and Post Mathematics Grade Point Averages, Changes, and Group Means for ABC and Control Groups, Over the Full School Year

ABC (n = 17)

Subject Number	Age	Prior Math GPA	Post Math GPA	Change
S1	18	1.6	1.0	-0.6
S2	16	1.0	3.0	+2.0
S3	18	1.0	1.5	+0.5
S4	17	1.0	3.0	+2.0
S5	17	2.0	3.5	+1.5
S6	18	1.5	2.0	+0.5
S7	18	1.5	2.0	+0.5
S8	17	1.0	1.5	+0.5
S9	18	1.0	0.0	-1.0
S10	16	0.0	0.0	0.0
S11	18	0.0	0.0	0.0
S12	16	2.0	2.0	0.0
S13	16	2.0	2.0	0.0
S14	19	1.7	2.0	+0.3
S15	17	2.0	3.0	+1.0
S16	17	1.0	1.0	0.0
S17	16	2.0	2.0	0.0
		M = 1.3	M = 1.7	M = 0.4
		S.D.= 0.6	S.D.= 1.0	S.D.= .8

Control (n = 17)

Subject Number	Age	Prior Math GPA	Post Math GPA	Change
S1	17	1.5	1.0	-0.5
S2	15	2.0	2.0	0.0
S3	17	1.0	1.0	0.0
S4	18	1.0	2.0	+1.0
S5	17	3.0	3.0	0.0
S6	17	1.5	2.5	+1.0
S7	15	1.5	1.0	-0.5
S8	17	2.0	2.0	0.0
S9	16	0.0	0.0	0.0
S10	17	0.0	0.0	0.0
S11	17	1.0	1.0	0.0
S12	17	2.0	2.0	0.0
S13	16	2.0	2.0	0.0
S14	17	1.5	1.5	0.0
S15	17	1.0	1.0	0.0
S16	16	1.0	0.0	-1.0
S17	15	2.0	0.5	-1.5
		M = 1.4	M = 1.3	M = -0.09
		S.D.= 0.7	S.D.= 0.9	S.D.= 0.6

An analysis of the covariance was performed using the prior GPA as the covariate, and the post GPA as the dependent measure. The results are presented in Table 5.

TABLE 5

Analysis of Covariance: Effect of ABC on Post Grade Point Average Over the Regular School Year

Source of Variation	SS	df	MS	F	Significance
ABC	2.199	1	2.199	4.192	.049
Residual	16.263	31	.426		

Summary

These data indicate that there was an overall gain in GPA for the ABC group, and that this difference was significant in an analysis of covariance at the .05 level. As indicated in Table 4, the average gain for the ABC group was +0.4 in GPA, while the Control group declined and average of -0.09. In the ABC group, nine students gained in GPA, six remained the same, and two students lost in GPA. The Control group reflected two gains in GPA, eleven remaining the same, and four losses. However, the total GPA gain for the ABC group was +8.8, while the Control group total gain was +2.0.

These results suggest that an improvement of the treatment effect will yield a more significant performance change. Finally, the effect of the treatment upon the students could be strengthened by extending the program to eight weeks to allow for more depth and detail into the mathematical concepts.

Overall Summary

The literature review presented a variety of teaching methods used in Upward Bound programs. However, there are such differences between programs that what works best for one teacher will not necessarily be an effective model for another instructor. The reading method reviewed by Rushmore and Scope (1969), resulted in affective gains but yielded no significant academic gains. However, the reading program developed by Lloyd (1968) indicated significant academic and social gains as measured by a pre-test and a post-test. These results suggest that there is no one method that works in all programs, but rather that a variety of techniques should be considered, with additional research necessary. Hopefully, additional quantitative and qualitative results will be publicized so that working models will increase over time.

Reference Note

[1]Office of Economic Opportunity, Upward Bound Guidelines (Washington, D.C., 1965), page 1.

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